REMARKS

In view of the above amendments and following remarks, reconsideration and further examination are requested.

Initially, a replacement formal drawing is provided for Fig. 4 which identifies stopper 106 and protrusion 106a in this figure. Accordingly, it is respectfully submitted that the drawing objection to Fig. 4 has been obviated.

The specification and abstract have been reviewed and revised to make editorial changes thereto and generally improve the form thereof, and a substitute specification and abstract are provided. No new matter has been added by the substitute specification and abstract.

By the current Amendment, claims 1-12 have been canceled and new claims 13-31 have been added. New claims 13-31 have been drafted taking into account the 35 U.S.C. § 112, second paragraph, issues raised by the Examiner, are believed to be free of these issues, and are otherwise believed to be in compliance with 35 U.S.C. § 112, second paragraph.

In the Office Action mailed August 14, 2006: claims 1, 2, 6 and 7 were rejected under 35 U.S.C. § 102(b) as being anticipated by Suzuki et al.; claims 1, 2, 6 and 7 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Suzuki et al.; claims 4 and 8 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Suzuki et al. in view of Park; and claims 3, 5, 7, 9, 10, 11 and 12 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Suzuki et al. in view of Park, and further in view of Garry and Chuang.

In view of the positions taken by the Examiner new claim 13 is presented, which makes it clear that the protrusion is a curved protrusion, as shown in Fig. 2 for example. None of Suzuki et al., Chuang, Garry nor Park discloses or suggests a stopper for use in a hermetically sealed electrically driven compressor, which stopper has a curved protrusion as required by claim 13.

In this regard, in the first embodiment of Suzuki et al. (Fig. 3), the protrusion 17 is not shown to be curved. Similarly, the protrusion 117 in the second embodiment of Suzuki et al. (Fig. 4) is also not shown to be curved. In Park, the stopper 50 has no protrusion extending from an inner surface thereof, and Chuang and Garry are from a non-analogous art.

Thus, because the references relied upon by the Examiner, either taken alone or in combination, do not teach or suggest a compressor including a stopper having a curved protrusion as required by claim 13, claim 13 is allowable over these references either taken alone or in combination.

Additionally, claims 14, 22 and 26 are believed to be patentable in their own right because these claims recite limitations that are not taught or suggested by any of the relied-upon references.

In view of the above amendments and remarks, it is respectfully submitted that the present application is in condition for allowance and an early Notice of Allowance is earnestly solicited.

If after reviewing this Amendment, the Examiner believes that any issues remain which must be resolved before the application can be passed to issue, the Examiner is invited to contact the Applicants' undersigned representative by telephone to resolve such issues.

Respectfully submitted,

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Version with Markings to Show Changes Made

HERMETICALLY SEALED ELECTRICALLY DRIVEN COMPRESSOR

FIELD OF THE INVENTION

The present invention relates to a hermetically sealed electrically driven compressor used in a refrigerator, freezer, air conditioner, dehumidifier, ~~etc~~and the like.

BACKGROUND OF THE INVENTION

A conventional hermetically sealed electrically driven compressor comprises an enclosed container, and motor elements and compressor elements included in this enclosed container. Such conventional hermetically sealed electrically driven compressor (hereinafter called compressor) is disclosed, for example, in Japanese Laid-open Patent No. H11-303740 or United States Patent No. 5,118, 263.

A conventional compressor is described below while referring to ~~the~~ drawings.

Fig. ~~4~~ 5 shows a compressor 10, in which an enclosed container 20 is formed of an upper case 20A and a lower case 20B joined by welding or the like at mutual open edges.

An electrically driven compressor body (hereinafter called compressor body) 30 is elastically supported and contained in this enclosed container 20 by way of a plurality of elastic support devices 40. A motor element 50 is disposed in ~~the~~ an upper part in the enclosed container 20, and includes a stator 60 and a ~~rotator~~ rotor 70. A compressor element 80 is disposed in the lower part in the enclosed container 20. A crankshaft 90 for coupling

the compressor element 80 and motor element 50 is provided on the ~~rotator~~ rotor 70.

A stopper 100 for inserting thereto ~~the~~ an upper end portion of the crankshaft 90 is disposed in the upper part in the enclosed container 20.

In the compressor configured in this manner, its operation is described below. The upper end portion of the crankshaft 90 is centrally inserted into ~~the center of the inside of~~ the stopper 100 fitted to the upper part in the enclosed container 20.

Thus, when transporting the compressor 10, the compressor body 30 is prevented from swinging into contact with ~~the~~ an inside of the enclosed container 20. As a result, the compressor body 30 is protected.

In ~~the~~ this conventional structure, ~~the~~ a condition of mounting and fixing the compressor 10 to ~~the~~ a refrigerator includes the following. In addition to ~~the~~ hardness and a mounting condition of ~~the~~ a vibration absorbing rubber preventing transmission of vibration of the compressor 10, ~~the~~ rigidity of a piping connection is involved. When these mounting and fixing conditions are stronger, the enclosed container 20 is fixed more firmly.

In these mounting conditions, when impact or vibration is applied from outside during operation of the compressor body 30, the following phenomenon occurs. By ~~the~~ motion of the elastically supported compressor body 30, the upper end portion of the crankshaft 90 hits against ~~the~~ an inner circumferential side of the stopper 100.

By ~~the~~ a rotating force of the crankshaft 90 and ~~the~~ friction of the inner circumferential side of the stopper 100, the crankshaft 90 repulses, and hits

against the inner circumferential side of the stopper 100 by this repulsive reaction. This state occurs repeatedly, and noise is generated due to contact by rotary motion along ~~the~~ an inner circumference of the stopper 100.

The invention is intended to solve these conventional problems, and present a compressor capable of suppressing occurrence of noise.

SUMMARY OF THE INVENTION

The invention presents a hermetically sealed electrically driven compressor comprising a compressor element elastically supported in an enclosed container, a crankshaft provided with ~~said~~ the compressor element, a motor element for driving ~~said~~ the compressor element, and a cup-shaped stopper fixed to ~~the~~ an inside upper part of ~~said~~ the enclosed container and having a protrusion at its inner circumferential side, wherein ~~the~~ an upper end portion of ~~said~~ the crankshaft extends into ~~said~~ the stopper.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a longitudinal sectional view of a compressor in accordance with a first exemplary embodiment of the present invention.

Fig. 2 is a perspective view of a stopper of the compressor in accordance with ~~a~~ the first exemplary embodiment of the present invention.

Fig. 3 is a perspective view of upper part of an enclosed container of a compressor in accordance with a second exemplary embodiment of the present invention.

Fig. 4 is a horizontal sectional view of the upper part of the enclosed

container of ~~a~~ the compressor in accordance with ~~a~~ the second exemplary embodiment of the present invention.

Fig. 5 is a longitudinal sectional view of a conventional –compressor.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of the compressor of the present invention are described below while referring to the accompanying drawings. Same parts as in the prior art are identified with same reference numerals, and detailed description thereof is omitted. The drawings are schematic ones and they do not indicate dimensional relationships of the elements.

(Exemplary embodiment 1)

As shown in Fig. 1, inside an enclosed container 101, a compressor element 103 elastically supported by a spring 102, and a motor element 104 fixed at ~~the~~ an upper side of the compressor element 103 for driving it are provided.

The compressor element 103 includes a compressor chamber 109, and a piston 108 for reciprocating in the compressor chamber 109.

A cup-shaped stopper 106 is fixed to ~~the~~ an inside upper part of the enclosed container 101. ~~The~~ An upper end portion of a crankshaft 105 extends into the stopper 106. The stopper 106 is fitted with a space relative to the upper end portion of the crankshaft 105 composing the compressor element 103. The space is approximately 2-10 mm. As shown in Fig. 2, a protrusion 106A is formed at ~~the~~ an inner circumferential side of the stopper 106. The protrusion 106A projects to ~~the~~ an inside by draw forming of the stopper 106, whereby ~~. The protrusion 106A is formed in a~~

~~shape of~~ a groove exists along an exterior surface of the stopper in ~~the~~ a vertical direction, and ~~the~~ a leading end of the protrusion 106A ~~is formed in~~exhibits a curvature. Thus, the protrusion 106A is formed integrally with the stopper 106 by draw forming. It is easy to form the protrusion~~,~~ without an extra cost. ~~In~~ For this structure, ~~the~~ an operation is described.

During operation of the compressor, due to fluctuation of compressor load or an external force ~~appling~~ applied to the enclosed container 101, the compressor element 103 elastically supported by the spring 102 oscillates. As a result, the upper end portion of the crankshaft 105 may contact ~~with the~~an inner ~~circumference~~ circumferential surface of the stopper 106. At this time, by ~~the own~~ rotation of the crankshaft 105, its contact portion with the stopper 106 is moved, and continuously rotates by rubbing against the inner ~~circumference~~ circumferential surface of the stopper 106. According to the present invention, however, the upper end portion of the crankshaft 105 collides against the protrusion 106A, and by ~~the~~ reaction of this collision, it further collides against the inner ~~circumference~~ circumferential surface of the stopper 106. As a result, occurrence of continuous rotary motion is prevented. Thus, generation of noise due to collision can be prevented, and ~~the~~ a refrigerator or the like using the compressor of present exemplary embodiment does not give any unpleasant feeling to its user.

Because ~~The~~ the protrusion 106A ~~has a vertical groove shape. Therefore~~extends vertically, if the compressor element 103 elastically supported by the spring 102 is moved vertically, the protrusion 106A and the upper end side of the crankshaft 105 collide against each other securely. Further, ~~the~~ a leading end of the protrusion is a curved surface instead of an

edge, and ~~the~~ rigidity of the protrusion is enhanced. As a result, if the protrusion 106A collides against ~~the~~ a leading end of the crankshaft 105, it is not deformed.

(Exemplary embodiment 2)

Exemplary embodiment 2 is described while referring to Fig. 1 and Fig. 4.

A compressor element 103 is elastically supported by springs 102 provided in supporting parts 110A, 110B, 110C, and 110D. Line segment A-A' shown in Fig. 4 shows ~~the~~ a direction of reciprocal motion of ~~the~~ piston 108. Line segment B-B' shows nearly ~~the~~ a center between the supporting parts 110A and 110B, and 110C and 110D. Line segment C-C' indicates a line ~~vertical~~ orthogonal to line segment A-A' through ~~the~~ a nearly central axis of ~~the~~ crankshaft 105 and stopper 106.

In the present exemplary embodiment, as compared with the compressor of exemplary embodiment 1, protrusion 106A is formed as shown in Fig. 3 and Fig. 4. The protrusion 106A is provided in a direction nearly ~~vertical~~ orthogonal to the direction of reciprocal motion of the piston 108 indicated by line segment A-A'.

The compressor of the present exemplary embodiment having such configuration has a cup-shaped stopper 106 fitted with a space relative to ~~the~~ an upper end portion of the crankshaft 105 composing the compressor element 103. The space is approximately 2-10 mm. The protrusion 106A is formed at ~~the~~ an inner circumferential side of the stopper 106. Accordingly, by ~~the~~ repulsion of a rotating force of the crankshaft 105, when the upper end portion of the crankshaft 105 starts rotary motion along ~~the~~

an inner ~~circumference~~ circumferential surface of the stopper 106, the upper end portion of the crankshaft 105 collides against the protrusion 106A. By ~~the~~ reaction of this collision, the upper end portion of the crankshaft 105 returns to ~~the~~ a normal position of the stopper 106 fitted with a space, so that rotary motion can be prevented.

~~The~~ A specific effect of the present exemplary embodiment is more specifically described by referring to Fig. 4. The compressor element 103 has its center of gravity near ~~the~~ compressor chamber 109, and a greater load is applied to the spring 102 at the compressor chamber 109 side corresponding to the left side from line segment B-B'.

On the other hand, the center of gravity of ~~the~~ motor element 104 is positioned near ~~the~~ an axis of the crankshaft 105, and a greater load is applied to the spring 102 at ~~the~~ an anti-compressor chamber 109 side corresponding to the right side from the line segment B-B'.

In particular, when starting or stopping the compressor, the vicinity of center of gravity of the compressor element 103 disposed in ~~the~~ a lower part of ~~the~~ enclosed container 101 and the vicinity of center of gravity of the motor element 104 disposed in ~~the~~ an upper part of the enclosed container 101 oscillate in turn. Consequently, a large vibration may occur, and a large vibration occurs in ~~the~~ a direction of line segment A-A' nearly coinciding with ~~the~~ linking the centers of gravity of the compressor element 103 and motor element 104. As a result, when starting or stopping the compressor, if ~~the~~ a spacing between the crankshaft 105 and stopper 106 is narrow, they collide against each other, and a loud impulse sound is generated. In the present exemplary embodiment, by contrast, the

protrusion 106A is provided in a direction ~~vertical~~ orthogonal to the direction of line segment A-A' as shown in Fig. 3. There is a relatively wide space between the crankshaft 105 and stopper 106, ~~therefore it~~which can lower ~~the~~ a possibility of a collision ~~of them~~between the crankshaft and stopper.

That is, the present exemplary embodiment has an original effect of reducing ~~the~~ noise at ~~the~~ a time of starting and stopping of the compressor, in particular.

As explained herein, according to the present invention, continuous rotary motion occurring between ~~the~~ crankshaft 105 and stopper 106 can be prevented, and occurrence of noise can be reduced.

The compressor of the present invention can be used widely in a refrigerator, freezer, air conditioner, dehumidifier, ~~etc~~and the like.

ABSTRACT OF THE DISCLOSURE

~~Contact noise occurring continuously in a hermetic electrically driven compressor is reduced.~~

A stopper ~~106~~ has a protrusion, ~~106A~~ projecting along ~~the~~ a vertical direction at ~~the~~ an inner circumferential side of the stopper, formed by draw forming. If vibration or impact is applied to an electrically driven compressor body ~~107~~ from outside during operation of the electrically driven compressor body ~~107~~, ~~the~~ an upper end portion of a crankshaft ~~105~~ prevents continuous rotary motion along ~~the~~ an inner circumferential side of the stopper ~~106~~. As a result, occurrence of noise can be reduced.